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Forest Insect and Disease Management

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BIOLOGICAL
EVALUATION R2-78-6

DWARF MISTLETOE SURVEYS

Arapaho and Roosevelt
National Forests
Redfeather
Ranger District

DECEMBER 1978

Rocky Mountain Region

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PREPARED BY: David W. Johnson
David W. Johnson
Supervisory Plant Pathologist

APPROVED BY:

G. L. DOWNING
Staff Director
Forest Insect and Disease Management

F. A. DORRELL
Deputy Regional Forester
State and Private Forestry

Forest Insect and Disease Management
State and Private Forestry
Rocky Mountain Region
USDA Forest Service
11177 W. 8th Avenue
Lakewood, Colorado 80225

ABSTRACT

An intensive survey to determine the distribution and intensity of lodgepole pine dwarf mistletoe was conducted during 1973, 1974, 1975 and 1977 on the Redfeather Ranger District, Arapaho and Roosevelt National Forests. Of the total 65,919 forested acres included in the survey, 39,264 acres have an overstory of lodgepole pine and 84.4 percent of these acres were infested with dwarf mistletoe. Thirty percent of the 24,980 acres with lodgepole pine understory also were infested. Annual volume loss to dwarf mistletoe for the survey area was estimated at 685,450 cubic feet or an average of 15.2 cubic feet per acre per year. Losses in pole-size stands (5.0 - 8.9 inches d.b.h.) averaged 5 cubic feet per acre per year; losses in sawtimber-size stands (9.0 inches d.b.h. and larger) averaged 27 cubic feet per acre per year. Recommendations for use of the information are presented.

INTRODUCTION

Lodgepole pine dwarf mistletoe, *Arceuthobium americanum* Nutt. ex Engel., is the most damaging disease agent of lodgepole pine, *Pinus contorta* Dougl., in the Rocky Mountain Region. The greatest damage caused by the disease is reduced height and diameter growth of infected trees. In addition to reduced increment, infection causes increased mortality, lower timber quality, reduced seed production and increased susceptibility to other damaging agents.

Dwarf mistletoe infected trees usually occur in distinct groups or centers of various sizes and shapes scattered through a stand. In the Rocky Mountain Region, we have thousands of acres of lodgepole pine that are in need of overstory removal and precommercial or commercial thinning. In addition stands not managed primarily for timber production would benefit from dwarf mistletoe by promoting a vigorous, more healthy forest in which other resource values would be enhanced. Management decisions must be made for each of these stands. Prior to the development of a silvicultural prescription, the land manager must have a complete description of each stand, including age, structure, stocking, and site index, together with reasonably accurate information on dwarf mistletoe distribution and intensity (if present). These kinds of data will also aid in establishing priorities for treatment of various stands.

During 1973, 1974, 1975, and 1977 the Forest Insect and Disease Management Group, State and Private Forestry, Rocky Mountain Region financed the Redfeather Ranger District, Arapaho and Roosevelt National Forests, to conduct surveys to determine the distribution and intensity of lodgepole pine dwarf mistletoe in lodgepole pine stands throughout the District (1, 2). The purpose of the survey was to identify and classify management units in need of dwarf mistletoe control that could be accomplished through timber sales and timber stand improvement work (3, 7, 8).

SURVEY PROCEDURE

Preparatory work included the mapping of lodgepole pine type and excluding non-type areas. Non-type areas included stands where lodgepole pine represented less than 50 percent of the stems. Also excluded were lodgepole stands with slopes exceeding 45 degrees, clearcuts, meadows, and non-regenerated burns. Transect lines were drawn on maps prior to field work.

The survey consisted of sample points at 10-chain intervals along parallel transects 10 chains apart. This provided a sampling intensity of one plot for every 10 acres. At each sample point a variable radius plot (BAF-10) was used to record overstory trees (over 25 feet tall) and a 0.01 acre circular plot was used to record understory trees (under 25 feet tall). Data collected included number of trees per plot, species, presence of dwarf mistletoe (DMR-dwarf mistletoe rating (6) for each overstory tree and percentage of stems infected for understory trees), diameter, height and age. Site index was measured for 20 percent of the plots. In addition information was collected on past treatment of the area and cone serotiny. Field data were transferred onto maps and acetate overlays. This information is stored in the District files. Detailed descriptions and maps of the areas surveyed by year are presented in the Appendix.

RESULTS

Results of the survey are presented by year in Tables 1, 2, 3, and 4. Table 5 summarizes the data for all years. Of the 65,919 forested acres surveyed, 39,264 acres had an overstory of lodgepole pine and 84.4 percent of these acres were infested with dwarf mistletoe. In comparison Hawksworth (5) conducted a roadside and plot survey on the Redfeather Ranger District during 1953-55 and reported that 48 percent of the miles adjacent to lodgepole pine type were infested with dwarf mistletoe. The Laramie River Ranger District which is now included in the Redfeather District was reported as 59 percent infested (5).

The stands varied from one-, two-, and three-storied to multi-storied in structure. At the lower and upper elevations, lodgepole pine was mixed with aspen and spruce-fir, respectively. The District has a varied history of timber harvest from clearcut to partial cut, including repeated entries in some stands. Tree density varied from dense or "dog hair" to scattered, overmature overstory. Regeneration was present to varying degrees in cut-over and partial cut stands. Of the total 24,980 acres with understory lodgepole pine, 29.8 percent were infested. Site index values ranged from 30 to 80. Overstory volumes per acre ranged from less than 3 MBF to more than 5 MBF.

In order to estimate the annual cubic foot volume loss due to dwarf mistletoe for the District, data from 4,700 lodgepole pine plots, representing the acreage sampled, were placed on punch cards and data segregated by computer into the following categories:

Table 1. Summary of 1973 dwarf mistletoe survey information by compartment and acreage infested with dwarf mistletoe.

Compartment	Total forested acres sampled (No.)	Lodgepole pine acreage					
		With overstory			With understory		
		Total (No.)	Infested (No.)	(%)	Total (No.)	Infested (No.)	(%)
Johnson Creek	6,387	5,540	5,342	96.4	1,242	281	22.6
Stuck Creek	2,184	952	798	83.8	250	131	52.4
Grace Creek	4,049	1,300	1,172	90.1	165	125	75.8
Totals	12,620	7,792	7,312	93.8	1,657	537	32.4

Table 2. Summary of 1974 dwarf mistletoe survey information by compartment and acreage infested with dwarf mistletoe.

Compartment	Total forested acres sampled (No.)	Lodgepole pine acreage					
		With overstory			With understory		
		Total (No.)	Infected (No.)	(%)	Total (No.)	Infested (No.)	(%)
Deadman	6,454	4,981	4,527	90.9	3,306	1,111	33.6
Sand Creek	3,387	1,409	717	50.9	1,463	568	38.8
Eaton	3,244	1,173	1,153	98.3	899	396	44.0
Osborn	3,349	3,093	2,946	95.2	1,982	1,208	60.9
George	3,610	1,629	1,529	93.9	922	454	49.2
North Poudre	2,069	696	696	100	---	---	--
Upper Panhandle	3,383	---	---	--	---	---	--
Totals	25,496	12,981	11,568	89.1	8,572	3,737	43.6

Table 3. Summary of 1975 dwarf mistletoe survey information by compartment and acreage infested with dwarf mistletoe.

Compartment	Total forested acres sampled (No.)	Lodgepole pine acreage					
		With overstory			With understory		
		Total (No.)	Infested (No.)	(%)	Total (No.)	Infested (No.)	(%)
South Panhandle	199	164	157	95.7	140	34	24.3
Pearl	835	738	616	83.5	709	195	27.5
Lookout	537	397	355	89.4	460	171	37.2
East Bald Mountain	1,385	1,009	769	76.2	1,043	243	23.3
Bald Mountain	680	326	272	83.4	426	26	6.1
Upper Lone Pine	2,271	1,176	803	68.3	1,012	140	13.8
Columbine	563	353	248	70.2	288	88	30.5
Upper Elkhorn	5,678	3,983	3,694	92.7	4,389	1,587	36.2
Seven Mile	1,700	1,357	952	70.1	644	215	33.4
Totals	13,848	9,503	7,866	82.8	9,111	2,699	29.6

Table 4. Summary of 1977 dwarf mistletoe survey information by compartment and acreage infested with dwarf mistletoe.

Compartment	Total forested acres sampled (No.)	Lodgepole pine acreage					
		With overstory			With understory		
		Total (No.)	Infested (No.)	Infested (%)	Total (No.)	Infested (No.)	Infested (%)
Deadman	1,578	1,066	725	68.0	952	112	11.8
Sand Creek	788	468	162	34.6	669	49	7.3
Nunn	4,223	3,052	2,265	74.2	1,599	120	7.5
Roaring	2,110	1,595	1,073	67.3	1,512	40	2.6
Tunnel	2,334	1,528	1,184	77.5	695	109	15.7
Twin Lake	804	390	318	81.5	94	37	39.4
Chambers	965	337	292	86.6	75	6	8.0
Big South	895	449	292	65.0	35	6	17.1
Trap	258	103	77	74.7	9	0	0.0
Totals	13,955	8,988	6,388	71.1	5,640	479	8.5

Table 5. Summary of dwarf mistletoe survey information for all years (1973, 1974, 1975, 1977).

Total infested acres sampled (No.)	Lodgepole pine acreage					
	With overstory			With understory		
	Total (No.)	Infested (No.)	(%)	Total (No.)	Infested (No.)	(%)
65,919	39,264	33,134	84.4	24,980	7,452	29.8

Site index (6 classes)

a. 30 - 39
b. 40 - 49
c. 50 - 59
d. 60 - 69
e. 70 - 79
f. greater than 80

Dwarf mistletoe infection levels - DMR (5 classes)

a. 0 - 2
b. 3
c. 4
d. 5
e. 6

Basal area $ft.^2$ (5 classes)

a. 0 - 49
b. 50 - 99
c. 100 - 149
d. 150 - 199
e. greater than 200

Average diameter (inches) (4 classes)

a. 0 - 3.9
b. 4.0 - 7.9
c. 8.0 - 11.9
d. greater than 12

Segregation of the data was necessary in order to reduce the number of yield tables needed for analysis. After plots were segregated into the above categories, 105 hypothetical stands were developed that represented the lodgepole pine resource over the entire District (Table 6). The computer program RMYLD (yield tables for even-aged and two-storied tree species in the Rocky Mountain region) (4) was then used to estimate cubic-foot volume loss from dwarf mistletoe for each stand based on the average DMR. The loss estimate was derived by making two consecutive runs of the model, the first with average DMR's derived from the data, and the second with all DMR's converted to zero to represent non-infested stands (Table 6). The latter simulated growth in all

Table 6. Redfeather Ranger District dwarf mistletoe data derived from survey - volumes in cubic feet

Stand No.	DMR	Acres represented	Net growth uninfested	Net growth infested	Volume difference	Total volume lost/10 yrs.
1	0	270	440	440	0	0
2	1	120	390	390	0	0
3	2	300	420	420	0	0
4	3	330	380	360	20	6,600
5	4	180	440	380	60	10,800
6	5	240	420	250	170	40,800
7	6	180	310	-50	360	64,800
8	0	370	240	240	0	0
9	1	260	270	270	0	0
10	2	310	230	230	0	0
11	3	280	230	220	10	2,800
12	4	320	160	130	30	9,600
13	5	390	160	60	100	39,000
14	6	320	160	-100	260	83,200
15	0	50	180	180	0	0
16	1	10	220	220	0	0
17	2	30	200	200	0	0
18	3	40	180	130	50	2,000
19	4	30	160	90	70	2,100
20	5	40	230	30	200	8,000
21	6	50	130	-110	240	12,000
22	0	470	960	960	0	0
23	1	530	680	680	0	0
24	2	890	700	700	0	0
25	3	760	660	600	60	45,600
26	4	650	750	660	90	58,500
27	5	430	400	210	190	81,700
28	6	210	650	-110	760	159,600
29	0	1,150	370	370	0	0
30	1	740	460	460	0	0
31	2	1,500	370	370	0	0
32	3	1,120	370	300	70	78,400
33	4	1,170	280	130	150	175,500
34	5	1,160	360	40	320	371,200
35	6	1,130	280	-210	490	553,700
36	0	120	250	250	0	0
37	1	70	450	450	0	0
38	2	100	340	320	20	2,000
39	3	80	320	200	120	9,600
40	4	150	310	120	190	28,500
41	5	110	200	-80	280	30,800
42	6	200	230	-250	480	96,000
43	0	750	630	630	0	0
44	1	1,020	840	830	10	10,200
45	2	1,300	590	590	0	0
46	3	1,030	700	670	30	30,900

Table 6. (continued)

Stand No.	DMR	Acres represented	Net growth uninfested	Net growth infested	Volume difference	Total volume lost/10 yrs.
47	4	860	370	280	90	77,400
48	5	400	390	220	170	66,000
49	6	220	430	-180	610	134,200
50	0	1,270	570	570	0	0
51	1	760	560	560	0	0
52	2	1,450	500	460	40	58,000
53	3	1,160	350	200	150	174,000
54	4	950	460	150	310	294,500
55	5	1,110	450	-20	470	521,700
56	6	1,200	240	-670	910	1,092,000
57	0	90	320	320	0	0
58	1	60	250	250	0	0
59	2	70	410	380	30	2,100
60	3	140	210	50	160	22,400
61	4	200	370	40	330	44,000
62	5	140	240	-190	430	60,200
63	6	320	430	-40	470	150,400
64	0	530	490	490	0	0
65	1	760	670	610	60	45,600
66	2	930	280	230	50	46,500
67	3	690	720	500	220	151,800
68	4	360	590	370	220	79,200
69	5	240	-2,200	-2,130	-70	-16,800
70	6	30	-820	-1,230	410	12,300
71	0	550	500	500	0	0
72	1	350	850	850	0	0
73	2	590	370	370	0	0
74	3	590	350	220	130	76,700
75	4	700	440	170	270	189,000
76	5	630	250	-230	480	302,400
77	6	530	510	-500	1,010	535,300
78	0	40	300	300	0	0
79	1	50	1,050	1,040	10	500
80	2	90	220	220	0	0
81	3	120	150	40	110	13,200
82	4	160	280	-20	300	48,000
83	5	190	210	-330	540	102,600
84	6	190	790	-590	1,380	262,200
85	0	670	-270	-270	0	0
86	1	470	-10	-10	0	0
87	2	730	-90	-90	0	0
88	3	510	-130	-130	0	0
89	4	250	-470	-490	20	5,000
90	5	90	-150	-320	170	15,300
91	6	30	-20	-250	230	6,900
92	0	370	-350	-350	0	0
93	1	230	210	210	0	0
94	2	380	-270	-270	0	0
95	3	540	-300	-310	10	5,400
96	4	270	190	110	80	21,600
97	5	260	-290	-430	140	36,400
98	6	160	140	-680	820	131,200
99	0	30	70	70	0	0
100	1	40	140	140	0	0
101	2	60	30	30	0	0
102	3	40	150	110	40	1,600
103	4	60	170	-120	290	17,400
104	5	40	-120	-490	370	14,800
105	6	60	190	-70	260	15,600
TOTALS		44,970	29,070	12,520	16,550	6,854,500

stands over the next 10-year period as if no dwarf mistletoe infection were present.

Only 15 percent of the acres represented by the stands had no dwarf mistletoe present. More than 53 percent of the acres had a DMR of 3 or greater. Dwarf mistletoe has little effect on growth of stands with a DMR below 3. Based on the projected yield of these stands the annual cubic foot volume loss is 685,450 for the 44,970 acres represented. This is an average annual loss of 15.2 cubic feet per acre (5 cubic feet per acre per year for pole-size stands - 5.0 to 8.9 inches d.b.h.; 27 cubic feet per acre per year for sawtimber-size stands - 9.0 inches d.b.h. and larger) and represents 43 percent of the average net growth. These loss figures are predictions for even-aged, managed stands; however, the majority of the area surveyed has received little or no management, thus these loss figures may be very conservative.

RECOMMENDATIONS

In order for the Forest to obtain the greatest benefit from the survey information the following recommendations are presented in order of priority:

1. Develop comprehensive management plans for all the compartments surveyed, including provisions for dwarf mistletoe suppression when needed to meet management objectives.

2. Incorporate a systematic approach to dwarf mistletoe suppression. The highest priority work is overstory removal which should be completed in the following order:

    a. Remove infected overstory trees in stands with reproduction between 10- and 20-years-old (Fig. 1).

    b. Remove infected overstory trees in stands with reproduction under 10-years-old.

    c. Schedule sales in partial-cut stands with scattered infected leave trees that contain pockets of infected, advanced reproduction over 20-years-old. It is important to remove infected overstory trees in all units as promptly as possible after regeneration is established in order to assure that developing stands do not become infested.

Fig. 1 Stands similar to this one were among those surveyed in 1973 in the Roach area. These are considered as number one priority for overstory removal to help minimize growth impact and assure productive stands.

3. Precommercial size stands should be surveyed using the dwarf mistletoe survey procedure recommended for gathering input for the RMYLD computer program (8). After the best management alternatives are selected from the RMYLD projections, these stands can be ranked by priority and scheduled for thinning as funds become available.

4. Incorporate the summary information into the Arapaho and Roosevelt National Forests Plan and utilize this information in analyzing effects of alternatives in the Forest Plan.

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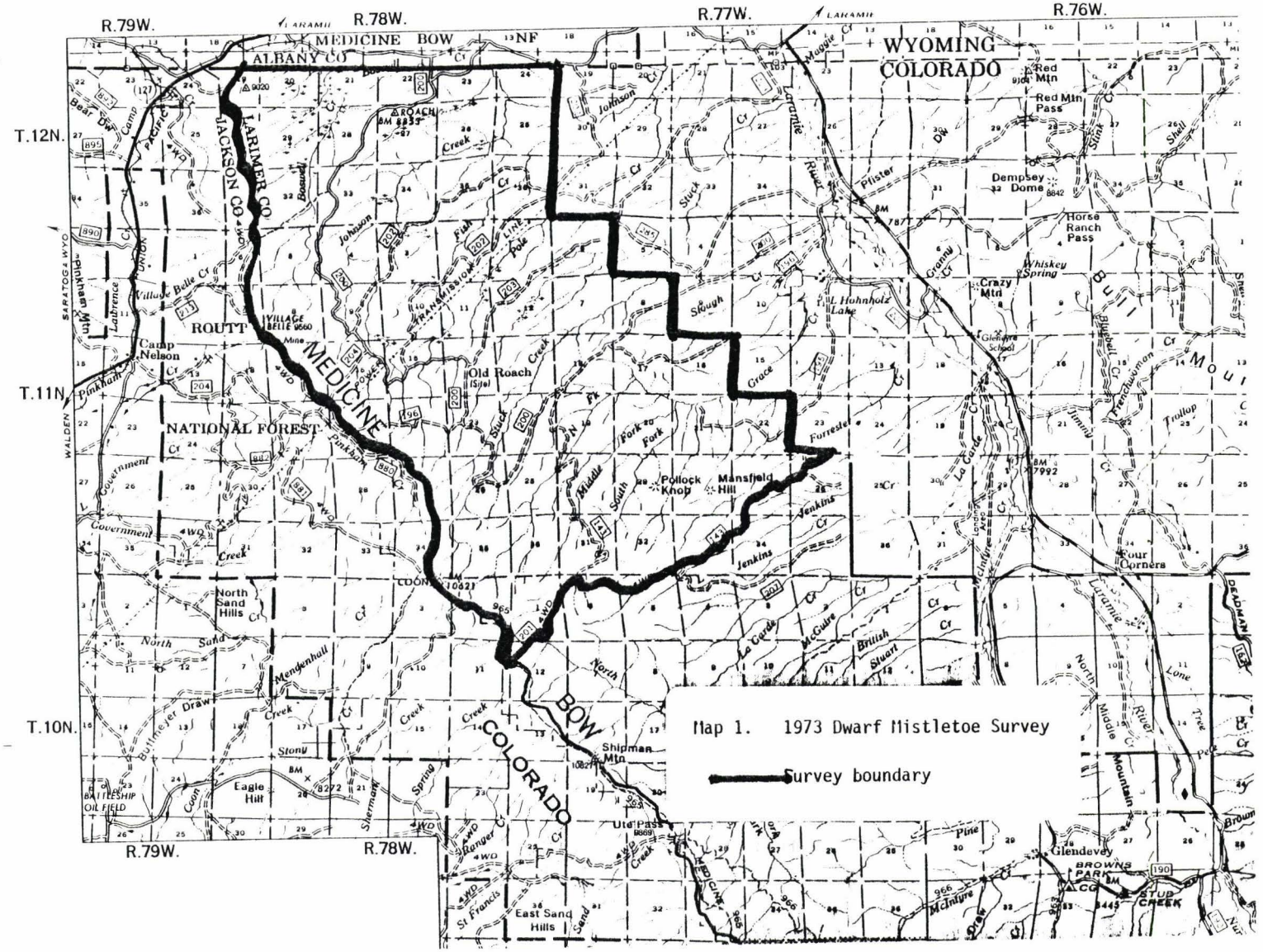
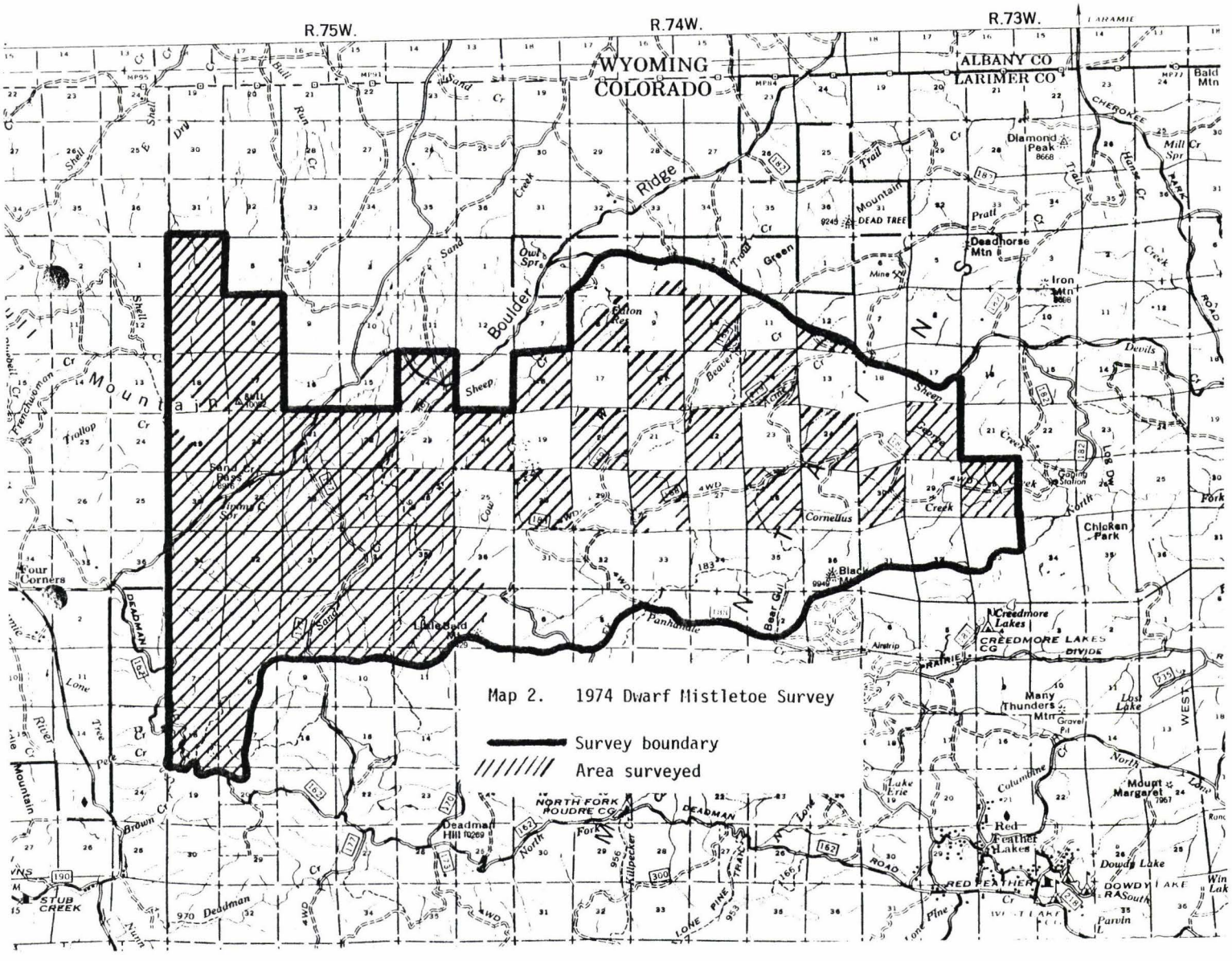
APPENDIX

DESCRIPTIONS OF AREAS SURVEYED

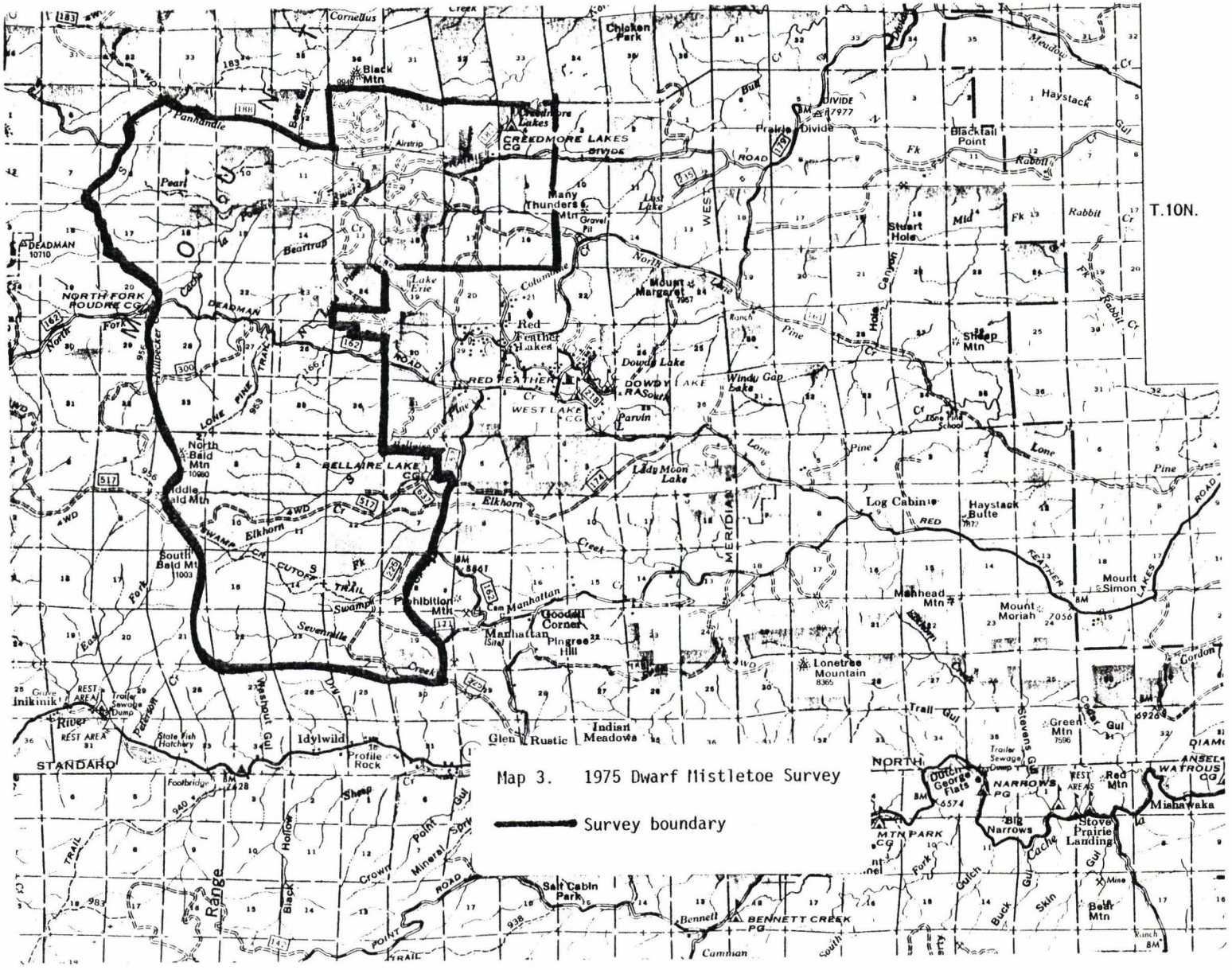
The 1973 survey was conducted in the area generally known as the "Roach" country. This area is north of Shipman Park, adjacent to and east of the Medicine Bow divide, but west of the Laramie River, and south of the Wyoming stateline. This area is in the northwest corner of Larimer County, Colorado, 6th P.M., in Sections 19, 20, 21, 22, 23, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, and 36 of T. 12 N., R. 78 W.; Sections 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 21, 22, 23, 24, 25, 26, 27, 34, 35, and 36 of T. 11 N., R. 78 W.; Sections 7, 18, 19, 20, 21, 22, 27, 28, 29, 30, 31, 32, 33, and 34 of T. 11 N., R. 77 W.; Sections 1, 2, and 12 of T. 10 N., R. 78 W.; and Sections 5 and 6 of T. 10 N., R. 77 W. The area is entirely within the Johnson Creek (001), Stuck Creek (002), and Grace Creek (003) timber compartments of the Redfeather District (see Map 1 - opposite page).


R.79W.
R.78W.
R.77W.
R.76W.
T.12N.
T.11N.
T.10N.
MEDICINE BOW NF
ALBANY CO
WYOMING
COLORADO
JACKSON CO
LARIMER CO
ROUTT
NATIONAL FOREST
MEDICINE BOW
COLORADO
Red Mtn
Red Mtn Pass
Dempsey Dome
Horse Ranch Pass
Crazy Mtn
L Hohnholz Lake
Camp Nelson
Old Roach
Pollock Knob
Mansfield Hill
Four Corners
North Sand Hills
East Sand Hills
Eagle Hill
Shipman Mtn
Ute Pass
Glendevey
BATTLESHIP OIL FIELD
Map 1. 1973 Dwarf Mistletoe Survey
Survey boundary

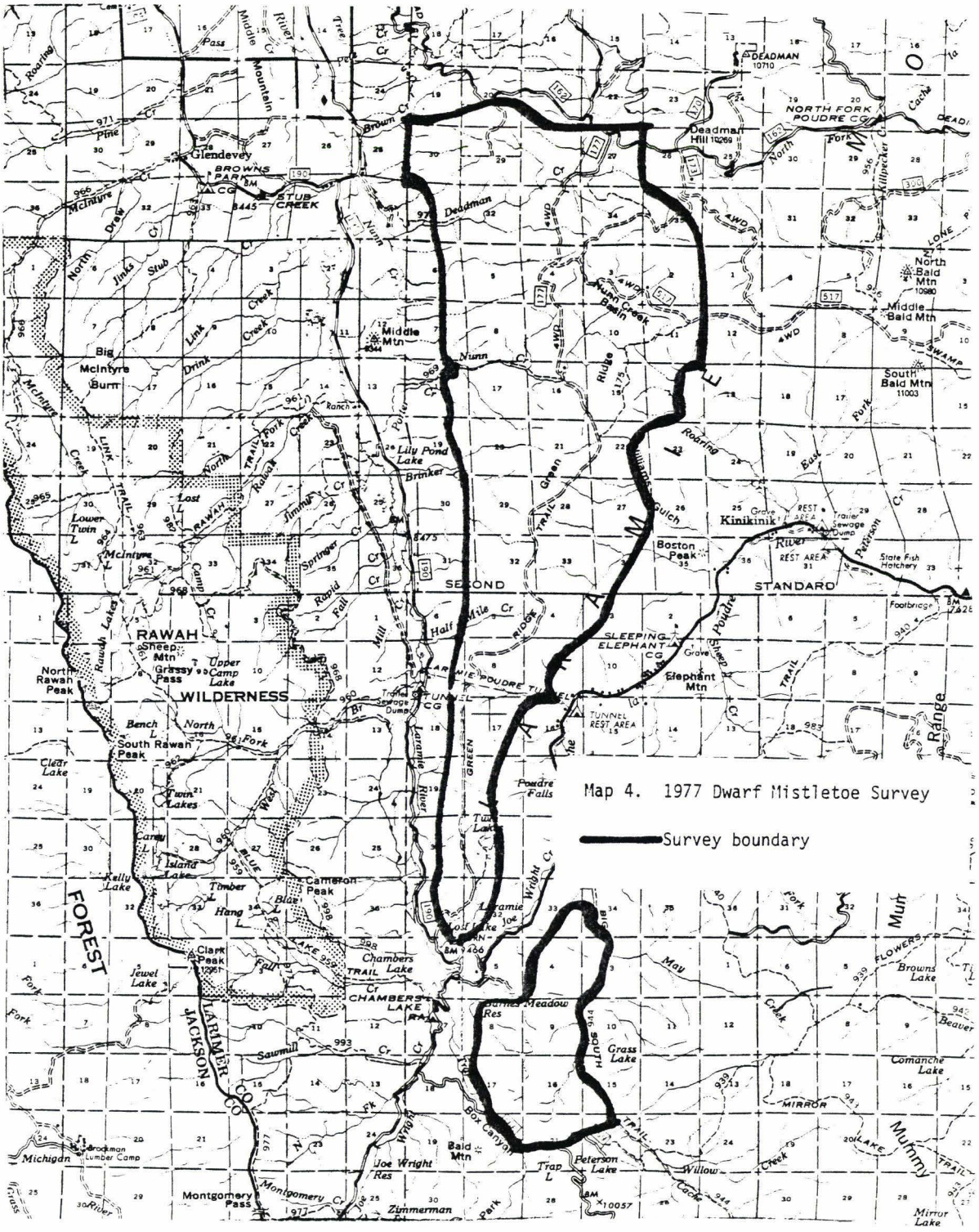
The 1974 survey was conducted in the vicinity of Deadman Hill. The area includes Bull Mountain, Eaton Reservoir, Sand Creek, Black Mountain, and Deadman. The area is east of the Laramie River, south of the Wyoming stateline, north of the Deadman Road, and west of Prairie Divide. This area is in the northern end of Larimer County, Colorado, 6th Principle Meridian in Sections 6, 7, 8, 14, 17, 18, 19, 20, 21, 22, 24, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, and 36 of T. 11 N., R. 75 W.; Sections 1, 2, 3, 4, 5, 6, 7. 8. 9. 10, 17, 18, 19, and 20 of T. 10 N., R. 75 W.; Sections 4, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30 of T. 11 N., R. 74 W.; and Sections 20, 28, and 30 of T. 11 N., R. 73 W. The area is entirely within the Deadman (018), Eaton (020), Osborn (021), Sand Creek (022), Upper Panhandle (023), George (041), and North Poudre (042) timber compartments of the Redfeather District. (see Map 2 - opposite page)


R.75W.
R.74W.
R.73W.
WYOMING
COLORADO
ALBANY CO
LARIMER CO
Map 2. 1974 Dwarf Mistletoe Survey
Survey boundary
Area surveyed

The 1975 survey was conducted in the area of Deadman Mountain. This area includes Creedmore Lakes area, Pearl Creek, east of Killpecker Creek, North, Middle, and South Bald Mountains, and Sevenmile Creek. This area is in the northern part of Larimer County, Colorado, 6th P.M. in Sections 1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 32, 33, 34, 35, and 36 T. 10 N., R. 74 W.; Sections 1, 2, 3, 4, 9, 10, 11, 12, 13, 14, 15, 16, 21, 22, 23, 24, 25, and 26 of T. 9 N., R. 74 W.; Sections 6, 7, 18, 19, 20, 29, and 30 of T. 9 N., R. 73 W. The area surveyed includes the following compartments: (025) South Panhandle, (026) Pearl, (027) Lookout, (029) East Bald Mountain, (031) Bald Mountain, (038) Upper Lone Pine, (039) Columbine, (037) Upper Elkhorn, and (036) Seven Mile (see Map 3 - opposite page).


T.10N.
Map 3. 1975 Dwarf Mistletoe Survey
Survey boundary

The 1977 survey was conducted in the vicinity of Green Ridge and Barnes Meadow. This area includes Deadman Park, Nunn Creek Basin, Green Ridge, Twin Lakes, and area east of Barnes Meadow Reservoir. This area is in the northern part of Larimer County, Colorado, 6th P.M. in Sections 20, 21, 27, 28, 29, 30, 31, 32, 33, 34, and 35 of T. 10 N., R. 75 W.; Sections 2, 3, 4, 5, 6, 7, 8, 9, 10, and 11 of T. 9 N., R. 75 W. The legal description of the remaining area was not available. The area is in T. 8 N., R. 75 W. and is known as Green Ridge. It is boardered by Cache La Poudre River on the east and the Laramie River on the west and extends to Chambers Lake to the south. Also, it includes an area (T. 7 N., R. 75 W.) east of the Cache La Poudre River known as Barnes Meadow. The area includes the following compartments: (008) Twin Lake, (012) Trap, (015) Big South, (016) Chambers, (017) Nunn, (018) Deadman, (022) Sand Creek, (032) Roaring, and (033) Tunnel (see Map 4 - opposite page).


Map 4. 1977 Dwarf Mistletoe Survey
Survey boundary
RAWAH WILDERNESS
FOREST
ROOSEVELT
NATIONAL
Range
Glendevey
BROWNS PARK
STUB CREEK
Middle Mtn
Big McIntyre Burn
Lily Pond Lake
Lost L
Lower Twin L
Upper Twin Lakes
Sheep Mtn
Grassy Pass
Upper Camp Lake
North Rawah Peak
South Rawah Peak
Bench L
Clear Lake
Island Lake
Kelly Lake
Timber L
Hang L
Cameron Peak
Clark Peak
Jewel Lake
Chambers Lake
CHAMBERS LAKE RA
Joe Wright Res
Baldy Mtn
Trap L
Peterson Lake
Willow Creek
Box Canyon
Montgomery Pass
Michigan
Brockman Lumber Camp
Zimmerman
Deadman Hill
DEADMAN
NORTH FORK POUDRE CG
North Bald Mtn
Middle Bald Mtn
South Bald Mtn
Kinikinik
Boston Peak
REST AREA
State Fish Hatchery
STANDARD
Footbridge
SECOND
Half Mile Cr
SLEEPING ELEPHANT CG
Elephant Mtn
TUNNEL CG
TUNNEL REST AREA
Poudre Falls
Laramie Lake
Laramie Meadow Res
Grass Lake
Comanche Lake
Browns Lake
Beaver
Mirror Lake
Mummy Range
Peterson Lake
Trailer Sewage Dump
Grove
Lone Pine
Swamp
Footbridge